Manual No.: DLA-50T-MM1

Issued: March 1993

Pages 1-54

DLA-50T SYSTEM

MAINTENANCE MANUAL

SOLID STATE REFRIGERATOR

BIOMEDICAL, DRUGS AND WHOLE BLOOD

REFRIGERATOR DLA-50T PN A-2244-2

POWER SUPPLY PS-50B PN A-2160-3

RECORDER DTR-50-10 PN A-2224-2

NSN 4110-01-287-7111

THERMOPOL INC.

2468 DELTA LANE ELK GROVE VILLAGE, IL 60007
Telephone: (708) 595-1110 Fax: (708) 595-3123

THERMOPOL ONE-YEAR LIMITED WARRANTY

Solid State, Biological, Blood, Vaccine and Drug Storage and Transportation Refrigerators, are warranted by Thermopol Inc. to the original user against defects in workmanship or materials under normal use, for one year - after the date of shipment to the original customer. Any part which is determined by Thermopol Inc. to be defective in material or workmanship may be returned, shipping cost prepaid, to Thermopol Inc. for repair or replacement.

LIMITATION OF LIABILITY

To the extent allowable under applicable law, Thermopol's liability for consequential and incidental damage is expressly disclaimed. Thermopol's liability in all events is limited to, and shall not exceed, the purchase price paid.

WARRANTY DISCLAIMER

Thermopol Inc. has made a diligent effort to describe its products in this literature, accurately. However, the illustrations and descriptions are for the sole purpose of identification and do not express or imply a warranty that the products are fit a particular purpose, or that the products will strictly conform to the illustrations or descriptions.

PRODUCT SUITABILITY

Many states and localities have codes and regulations governing sales, construction, installation, and/or use of products for certain purposes. While Thermopol Inc. attempts to assure that its products comply with such codes, it cannot guarantee compliance, and cannot be responsible for how or where its products are installed or used. Before use of product, review the application, local rules, regulations, and voltage/current specifications. Be sure that the unit's use will comply.

PROMPT DISPOSITION

Thermopol Inc. will make a good faith effort for prompt correction or other adjustments with respect to items which prove to be defective within this limited warranty period of one year.

NOTIFICATION

All products are to be inspected by receiver upon arrival. Inspect container immediately for evidence of damage. Inspect contents for damage. If damaged, call or fax:

THERMOPOL INC.
PHONE: (708) 595-1110
FAX: (708) 595-3123

TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE #
	LIST OF ILLUSTRATIONS	**4**
1	**DLA-50T DESCRIPTION AND OPERATION**	**6**
	1-0 Unpacking the DLA-50T	6
	1-1 General	7
	1-2 Description and Specifications	13
	1-3 Functional Description of the System	14
	1-4 Heat Pumping System	16
	1-5 Temperature Control, Thermometer & Alarm System	17
	1-6 Electronic Parts List, CAT-024	19
	1-7 Remote Thermometer / Recorder Connection	32
2	**PREVENTIVE MAINTENANCE**	**33**
	2-1 General	33
3	**TROUBLESHOOTING**	**34**
	3-1 General	34
	3-2 Troubleshooting List	35
4	**CORRECTIVE MAINTENANCE**	**36**
	4-1 General	36
	4-2 T.E. Assembly	36
	4-3 Temperature Control Thermistor T1	39
	4-4 Thermometer Thermistor T2	40
	4-5 Remote Thermometer/Recorder Thermistor T3	41
5	**POWER SUPPLY PS-50B**	**42**
	5-1 General	42
	5-2 Description and Specification	42
	5-3 Installation	42
6	**DTR-50-10 HARD COPY RECORDER**	**45**
	6-1 General	45
	6-2 Activation	45
	6-3 Removal	45

Table of Contents Continued

SECTION	DESCRIPTION	PAGE #
7	**EQUIPMENT**	**46**
	7-1 General	46
	7-2 List of Supplied Equipment	46
	7-3 List of Required Equipment - Not Supplied	46
8	**INSTALLATION**	**47**
	8-1 General	47
	8-2 Proper Location of Equipment	47
	8-3 Assembly Interconnections	47
9	**OPERATION**	**48**
	9-1 Initial Adjustments	48
	9-2 Starting, Operating and Stopping the Equipment	48
	9-3 Storage	51
10	**LIST OF REPLACEMENT PARTS**	**52**
	10-1 General	52
	10-2 List	52

LIST OF ILLUSTRATIONS

FIGURE		PAGE #
1	DLA-50T Blood Storage & Transportation Refrigerator	7
2	DLA-50T Exploded Front View	8
3	DLA-50T Exploded Rear View	9
4	DLA-50T Control Panel	10
5	DLA-50T Block Diagram	15
6	Thermoelectric Cooling/Heating Couple	16
7	Control Board CAT-024	17
8	Component Placement CAT-024	18
9	Control Performance	21
10	Temperature Control Section, Schematic CAT-024	23
11	Thermometer Section, Schematic CAT-024	25
12	Alarm Section, Schematic CAT-024	29
13	Alarm, Logic Diagram CAT-024	30
14	Control Panel, Wiring Diagram	31
15	DLA-50T, Wiring Diagram	32
16	T.E. Assembly	38
17	Power Supply PS-50B, Schematic	43
18	Attaching the PS-50B	44
19	Schematic Diagram of the Complete DLA-50T System	54

Section 1
DLA-50T Description and Operation

1-0. Unpacking the DLA-50T

1. Inspect shipping box immediately for evidence of damage.
2. Stand the carton upright. (Note arrows)
3. Cut the plastic packing bands.
4. Pull up all top cover's flaps of shipping container.
5. Pulling from the top, lift the DLA-50T out of shipping box.
6. Open unit, and remove all inside contents.
7. Verify contents to include:
   - 1 - Power Supply (PS-50B)
   - 2 - Maintenance Manuals (DLA-50T-MM1)
   - 2 - Operational Manuals (DLA-50T-OP1)
   - 1 - Wire Basket (WB-30B)
   - 1 - DC Power Cable (PC-30B)
   - 1 - Temperature Recorder (DTR-50-10)
8. Inspect contents immediately for damage.

If the unit or contents are defective or damaged, contact factory within 24 hours.

Phone (708) 595-1110
Fax (708) 595-3123

or notify in writing to:

Thermopol Inc.
2468 Delta Lane
Elk Grove Village, IL 60007

1-1. General

The DLA-50T is a solid state refrigerator/heater unit designed to keep the contents of the load compartment at the blood storage temperature, over the operational ambient range.

The unit has no moving parts, and does not require fans, motors, gas or air pressure. Cooling is performed by thermoelectric technology.

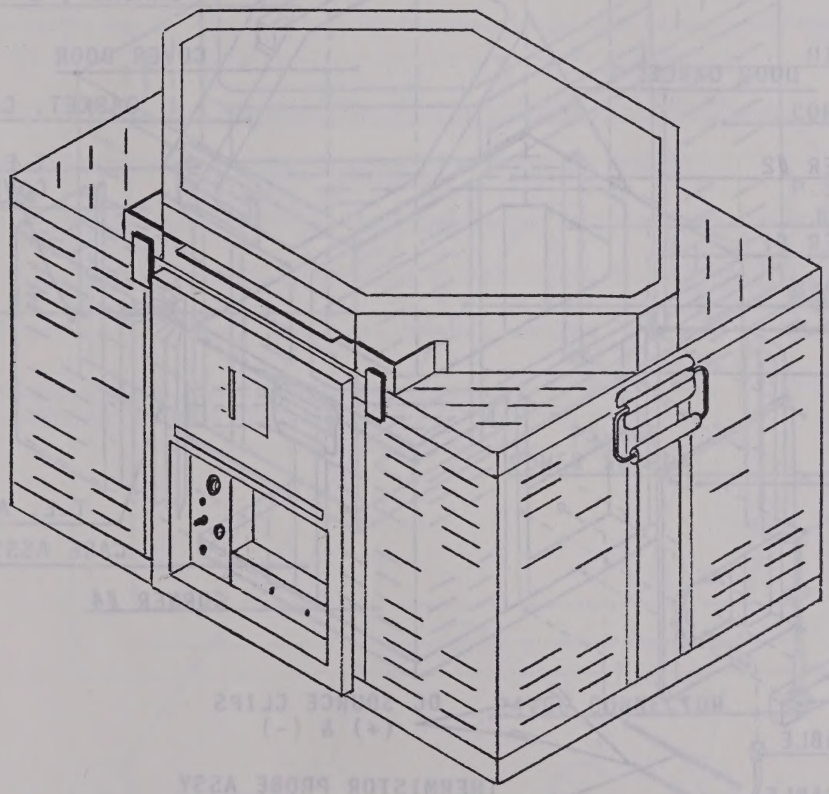


Figure 1
DLA-50T Blood Storage and Transportation Refrigerator

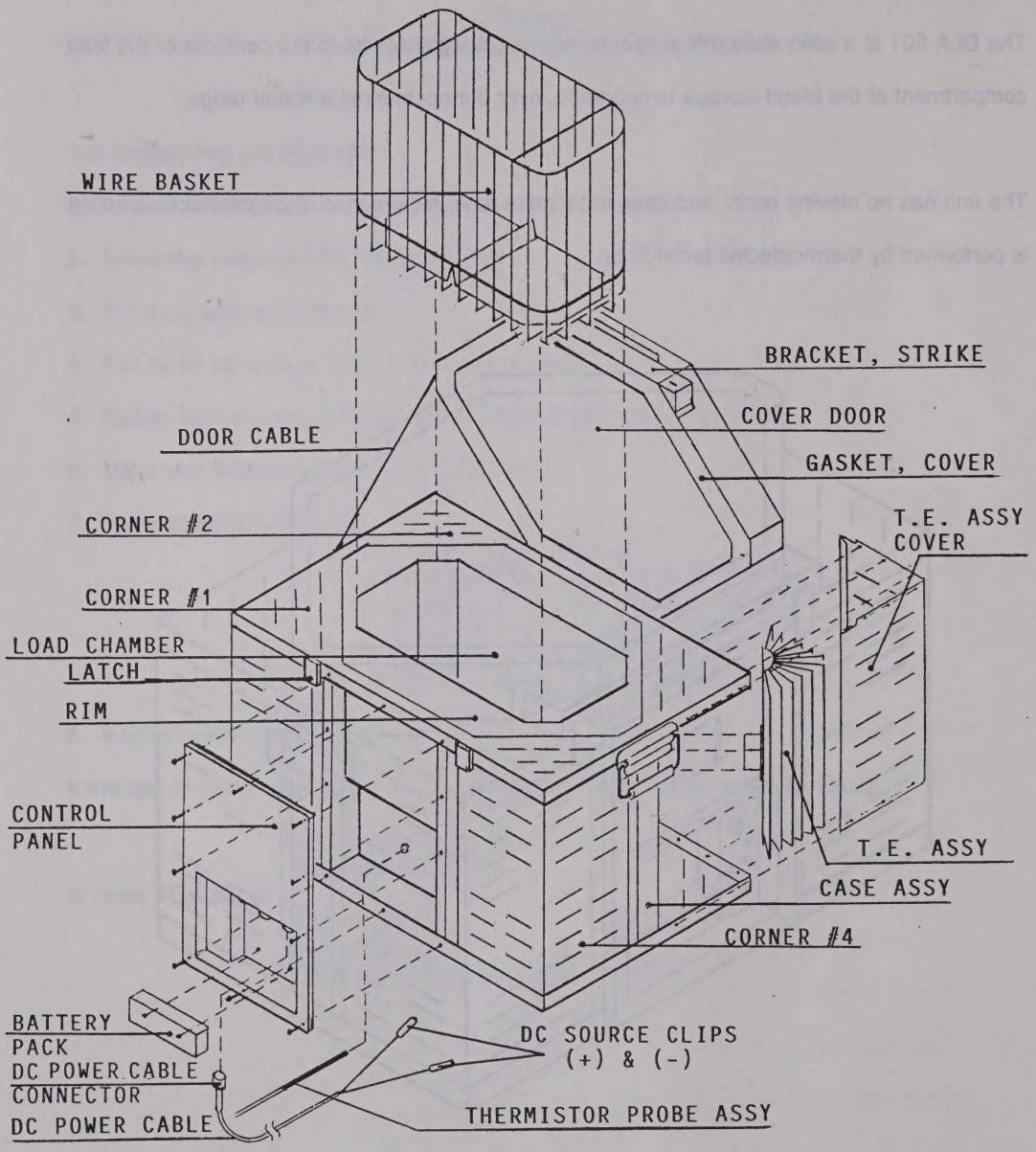


Figure 2
DLA-50T Exploded Front View

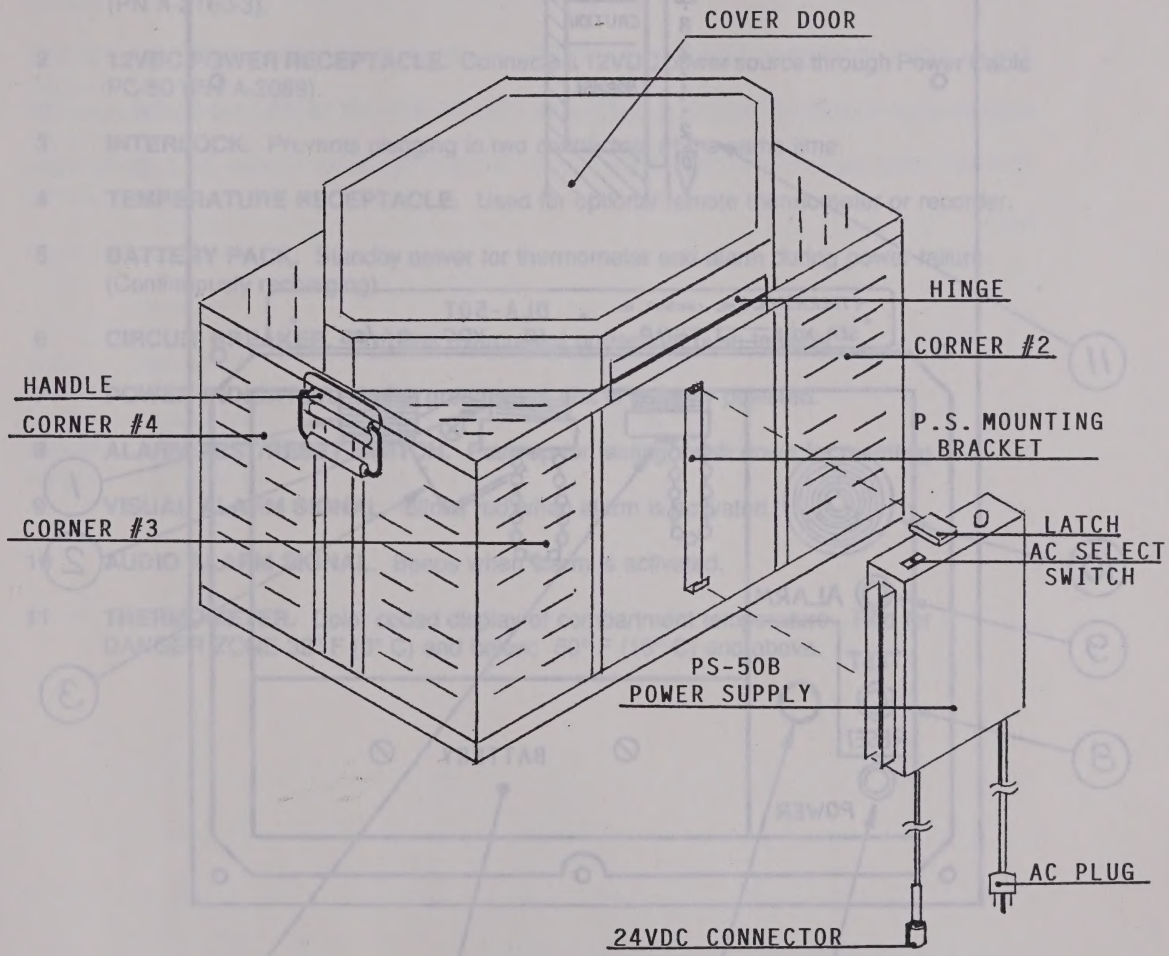


Figure 3
DLA-50T Exploded Rear View

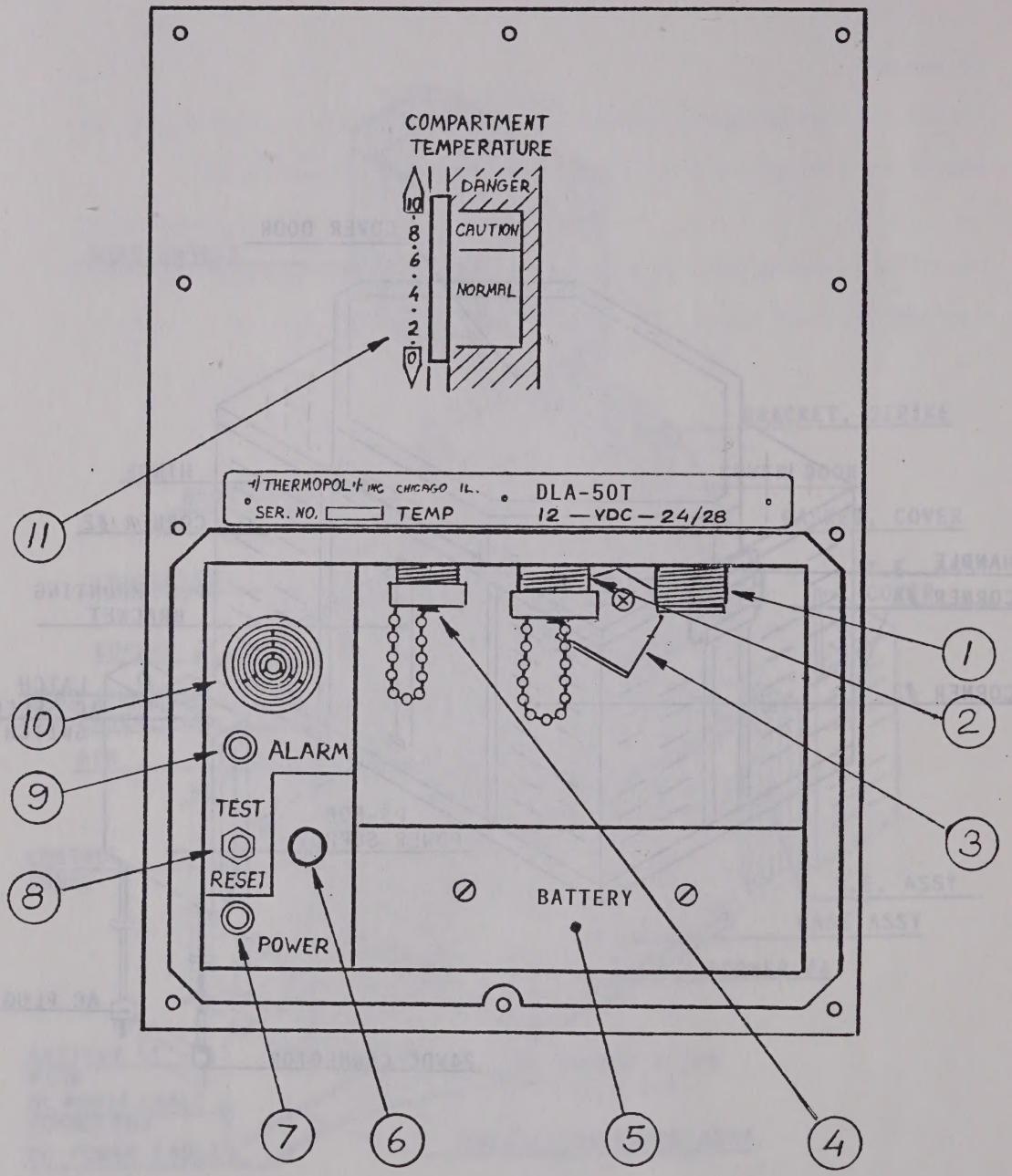


Figure 4
DLA-50T Control Panel

DLA-50T Control Panel Function Description

Item	Function/Description
1	**24/28VDC POWER RECEPTACLE.** Connects a 24/28VDC power source through Power Cable PC-50 (PN A-2089). Alternatively, connects Power Supply PS-50B (PN A-2160-3).
2	**12VDC POWER RECEPTACLE.** Connects a 12VDC power source through Power Cable PC-50 (PN A-2089).
3	**INTERLOCK.** Prevents plugging in two connectors at the same time.
4	**TEMPERATURE RECEPTACLE.** Used for optional remote thermometer or recorder.
5	**BATTERY PACK.** Standby power for thermometer and alarm during power failure. (Continuously recharging).
6	**CIRCUIT BREAKER.** Provides overcurrent protection, push to reset.
7	**POWER INDICATOR.** Lights green when unit is properly powered.
8	**ALARM TEST/RESET SWITCH.** Push up for testing, push down for resetting.
9	**VISUAL ALARM SIGNAL.** Blinks red when alarm is activated.
10	**AUDIO ALARM SIGNAL.** Beeps when alarm is activated.
11	**THERMOMETER.** Color coded display of compartment temperature. Red for DANGER ZONE 32° F (0° C) and below; 50° F (10° C) and above.

1-2. Description and Specifications

The unit is a modified commercial blood and vaccine transportation unit designed for operation in military environments.

The DLA-50T operates on 12VDC or 24-28VDC and can be plugged into a 120VAC or 220VAC main, through a rectifier Power Supply PS-50B. The PS-50B can be mounted on the unit. The DLA-50T inner capacity is approximately 1 cubic foot and can accommodate 37 X 450ml blood bags.

DLA-50T SPECIFICATIONS

Electrical Specifications for the DLA-50T are listed below:

Voltage	Current
12VDC Nominal	7 Amps Max.
24/28VDC Nominal	4.5 Amps Max.
120VAC, 50Hz	1.6 Amps Max.
120VAC, 60Hz	1.6 Amps Max.
220VAC, 50Hz	0.8 Amps Max.
220VAC, 60Hz	0.8 Amps Max.

Physical Dimensions

	Outside	Inside
Width	26in/66cm	16.9in/43cm
Depth	19.3in/48.9cm	8.5in/21.6cm
Height	18.5in/47cm	11.8in/30cm
Volume	5.4 Cu. Ft/0.15 Cu. M	1 Cu. Ft./28 Liter
Weight	68 lbs/31 Kg	

1-3. Functional Description of the System

The Block Diagram as shown (Page 15 Figure 5), describes the functions of the components and their interrelationships, required for the operation of the DLA-50T Solid State Refrigerator System.

The purpose of the DLA-50T unit is to maintain a constant, preset COMPARTMENT temperature of 33.8° F (1° C) to 42.8° F (6° C) for blood transportation and storage needs.

The DLA-50T utilizes a solid state thermoelectric effect, in its HEAT PUMPING SYSTEM. At high ambient temperatures, heat is pumped out of the COMPARTMENT thereby cooling it. At low ambient temperatures, heating is achieved by reversing the pumped heat direction. The heat flow direction is controlled by the current direction in the solid state HEAT PUMPING SYSTEM (module) to keep the COMPARTMENT temperature constant. The TEMPERATURE CONTROL automatically determines the duty cycle and direction of the heat pumped.

SENSOR T1 reacts to the COMPARTMENT temperature. It continuously provides the command signal to the TEMPERATURE CONTROL.

The POWER INPUT SECTION provides the DLA-50T with the power source voltage, by plugging the POWER CABLE of either the AC, via the PS-50B Power Supply, or a DC source into the appropriate receptacle in the Front Panel, (Page 10 Figure 4). This section also provides the resettable overcurrent and reverse polarity protection.

The DLA-50T ALARM system and THERMOMETER are powered by an independent BATTERY PACK to safeguard the temperature integrity of the COMPARTMENT temperature. The THERMOMETER measures and displays the COMPARTMENT temperature. The input signal is fed from SENSOR T2 which senses the temperature inside the load COMPARTMENT.

An audio-visual ALARM is triggered when the temperature inside the COMPARTMENT falls outside the acceptable range of 35.6° F (2° C) to 42.8° F (6° C). The alarm is manually resettable.

The ALARM system and the THERMOMETER are powered by a continuously recharging BATTERY PACK, for standby operation during a power failure

SENSOR T3 provides an output signal for an optional remote thermometer or recorder.

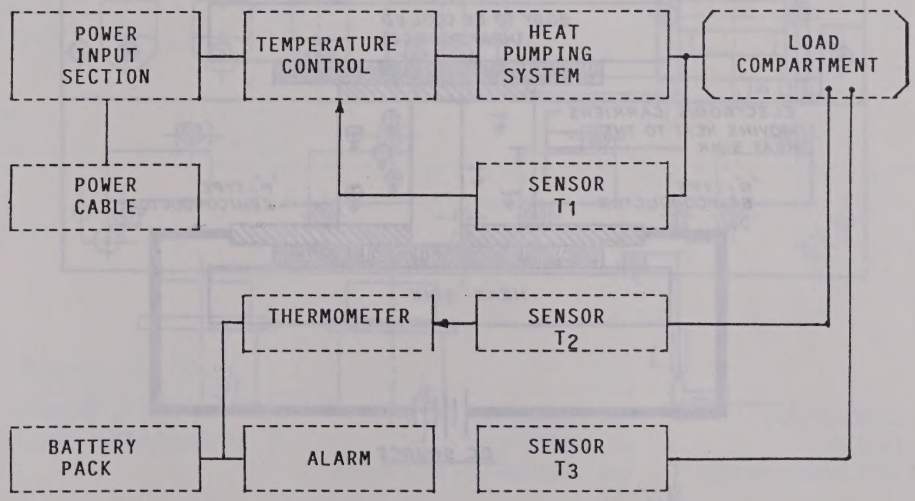


Figure 5
DLA-50T Block Diagram

1-4. Heat Pumping System

The DLA-50T utilizes the thermoelectric effect as its heat pumping device. When electric current passes through a junction of two dissimilar conductors, a thermocouple heat is absorbed and a cooling effect is produced at the junction.

The thermoelectric cooling couples (Page 16 Figure 6) are made of two elements of semiconductor material, primarily Bismuth Telluride, heavily doped to create an excess (N Type) or deficiency (P Type) of electrons. Heat absorbed at the cold junction, is pumped to the hot junction at a rate proportional to carrier current passing through the circuit, and the number of couples. Couples are connected in series electrically and in parallel thermally to form a Thermoelectric Module. The direction of the current flow dictates the heating mode of the load compartment under low temperature environmental conditions.

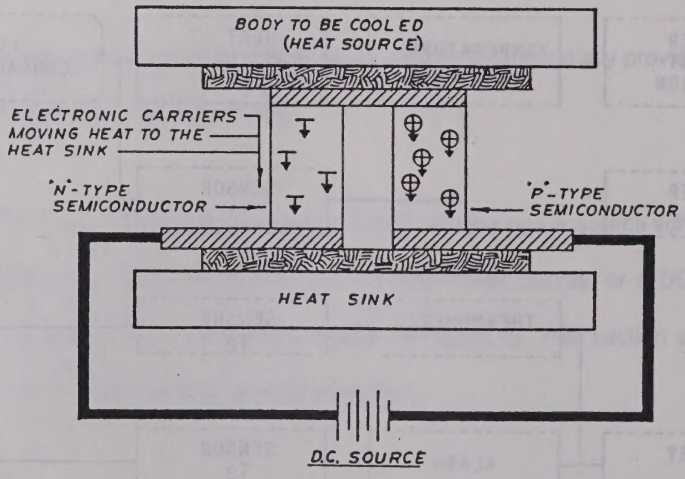


Figure 6
Thermoelectric Cooling/Heating Couple

1-5. Temperature Control, Thermometer and Alarm Systems

The Control Board CAT-024 Figure 7, provides the (A) temperature control, (B) thermometer and (C) alarm functions for the DLA-50T. Component placement is on Page 18 Figure 8. The board is mounted on the inside of the Control Panel. The board contains 3 sections as follows:

(A) Temperature Control Section D-2204 Page 23 Fig. 10

(B) Thermometer Section D-2202 Page 25 Fig. 11

(C) Alarm Section D-2203 Page 29 Fig. 12

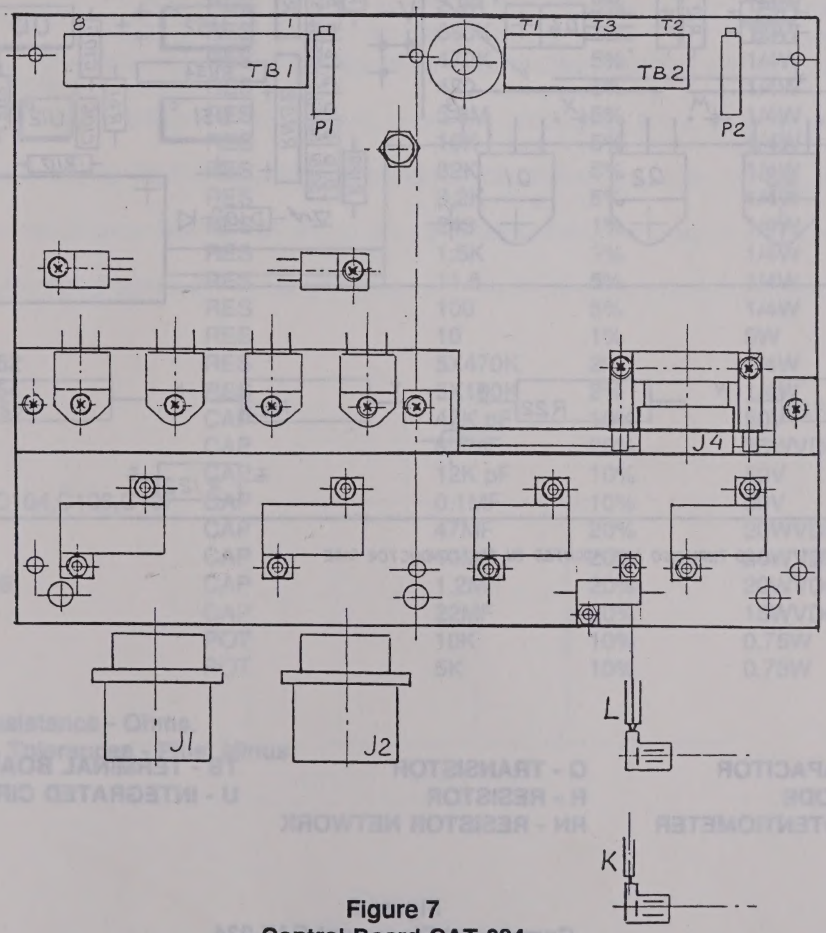
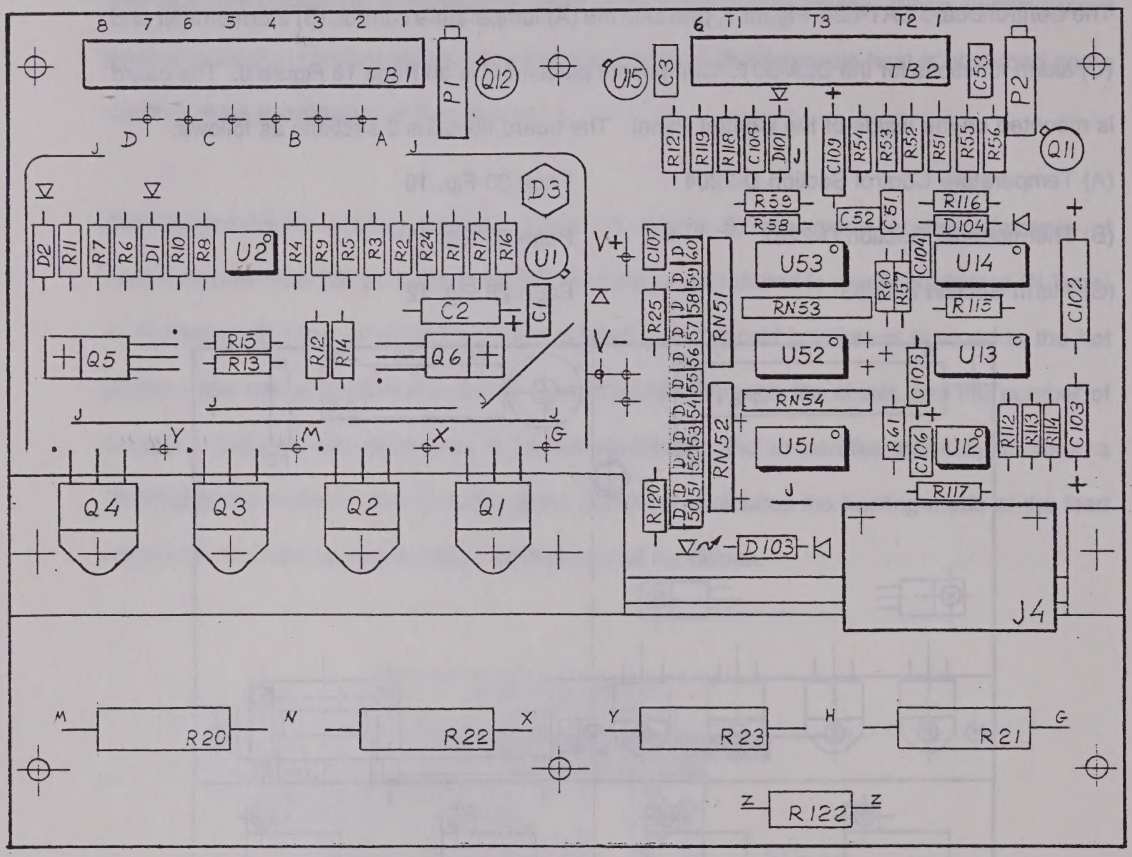


Figure 7
Control Board CAT-024



NOTE: D50 THRU D60 ARE MOUNTED ON THE CONDUCTOR SIDE

C - CAPACITOR
D - DIODE
P - POTENTIOMETER
Q - TRANSISTOR
R - RESISTOR
RN - RESISTOR NETWORK
TB - TERMINAL BOARD
U - INTEGRATED CIRCUIT

Figure 8
Component Placement CAT-024

1-6. Electronic Parts List, CAT-024

R1,R3,R51,R52,R53	RES	30.1K	1%	1/4W
R2	RES	221	1%	1/4W
R4,R5,R6,R7,R54,R55	RES	100K	5%	1/4W
R8,R9	RES	10M	5%	1/4W
R10,R11,R116,R117	RES	1K	5%	1/4W
R12,R13	RES	22K	5%	1/4W
R14,R15	RES	4.7K	5%	1/4W
R16	RES	270	5%	1/4W
R17	RES	1620	1%	1/4W
R20,R21	RES	40	1%	25W
R22,R23	RES	12	1%	25W
R24	RES	22.1	1%	1/4W
R25	RES	2.2K	5%	1/4W
R56,R57	RES	680K	1%	1/4W
R58,R113	RES	470K	5%	1/4W
R59	RES	470	5%	1/4W
R60,R61	RES	5.6M	5%	1/4W
R112	RES	10K	5%	1/4W
R114	RES	82K	5%	1/4W
R115	RES	8.2K	5%	1/4W
R118	RES	243	1%	1/4W
R119	RES	1.5K	1%	1/4W
R120	RES	11.5	5%	1/4W
R121	RES	100	5%	1/4W
R122	RES	10	1%	5W
RN51,RN52	RES	5X470K	2%	1/4W
RN53,RN54	RES	5X100K	2%	1/4W
C1	CAP	47K pF	10%	50V
C2	CAP	6.8MF	20%	35WVDC
C3,C53	CAP	12K pF	10%	50V
C51,C52,C104,C106,C107	CAP	0.1MF	10%	50V
C102	CAP	47MF	20%	20WVDC
C103	CAP	10MF	20%	20WVDC
C105,C108	CAP	1.2MF	20%	20WVDC
C109	CAP	22MF	20%	15WVDC
P1	POT	10K	10%	0.75W
P2	POT	5K	10%	0.75W

NOTE: Resistance - Ohms.
% Tolerances - Plus, Minus.

CONTINUED

Q1,Q3	TIP 36B	PNP POWER TRANSISTOR
Q2,Q4	TIP 35B	NPN POWER TRANSISTOR
Q5,Q6	TIP 121	NPN POWER TRANSISTOR
Q11,Q12	2N2219	NPN POWER TRANSISTOR
U1,U15	LM 117 H	VOLTAGE REGULATOR
U2	LM 158 J	DUAL OPERATIONAL AMPLIFIER
U12	LM555	TIMER
U13,U14	MC 14001 BAL	QUAD 2 INPUT NOR GATE
U51,U52,U53	LM 124 J	QUAD OPERATIONAL AMPLIFIER
D1,D2,D104	IN 4148	DIODE
D3	MBR3545	SCHOTTKY RECTIFIER
D101,D103	IN4001	DIODE
D50,D60	LED RED MV57123	LED LAMP RED
D53,D54,D55	LED GRN MV54123	LED LAMP GREEN
D51,D52,D56,D57,D58,D59	LED YEL MV53123	LED LAMP YELLOW
T1,T2	NTC 10K	NEG TEMP COEF THERMISTOR
T3	NTC 3K	NEG TEMP COEF THERMISTOR
J1,J2	CONNECTOR MS-3102A-18-01P	BOX MOUNTING RECEPTACLE
J4	CONNECTOR AMP-205868-1	RECEPTACLE

Control Board CAT-024 - Temperature Control Section

Page 23 Figure 10 Circuit Description D-2204

The Thermistor T1 senses the temperature at the control point. A change of temperature at T1 causes a change of its resistance and a corresponding voltage change at point III of the sensing bridge. The sensing bridge also consists of R1 and R3 with values close to the set point of T1, and P1 with R24 for the purpose of adjusting the set point. For adjustment procedure, see Page 39 Section 4-3 Para. 11.

The bridge voltages are applied to the bipolar op-amps U2 serving as voltage comparators. When the voltage III is higher than voltage II, the system will operate in the Heat Mode. When the voltage III is lower than voltage I, the system will operate in the Cool Mode. The gap between the two modes is determined by R2, and is directly proportional to the value of the resistor. The following figure shows the control performance of the Temperature Control Section:

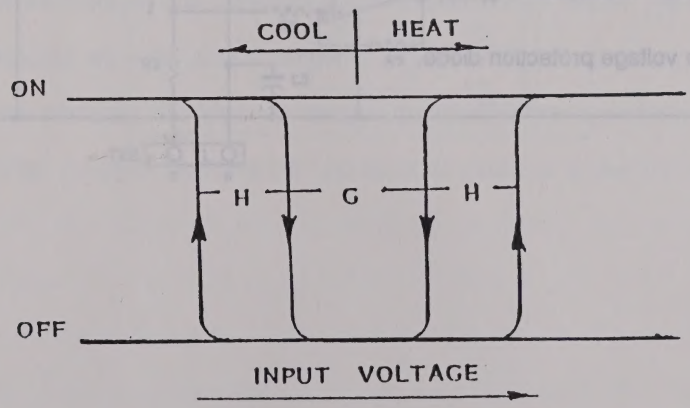


Figure 9
Control Performance

The width H of the hysteresis loop represents the on-off temperature difference in the Cool and Heat Modes. The width G represents the gap between the Cool and Heat modes. The built-in hysteresis assures that only one mode can be in operation at a time. R4, R5, R6, R7 are input resistors and determine the hysteresis. The hysteresis width is directly proportional to the values of these resistors. R8, R9 are positive feedback resistors.

R10,R11 are current limiting resistors for U2. D1, D2 establish the threshold and prevent backflow. The output of U2 is applied to the bases of Darlington drivers Q5, Q6. R20, R21, R22, R23 are current limiting resistors.

Transistors Q2, Q3 conduct in the Heat Mode. Transistors Q1, Q4 conduct in the Cool Mode.

U1 is the voltage regulator. The stabilized output voltage is supplied to the Temperature Control Section.

D3 is a reverse voltage protection diode.

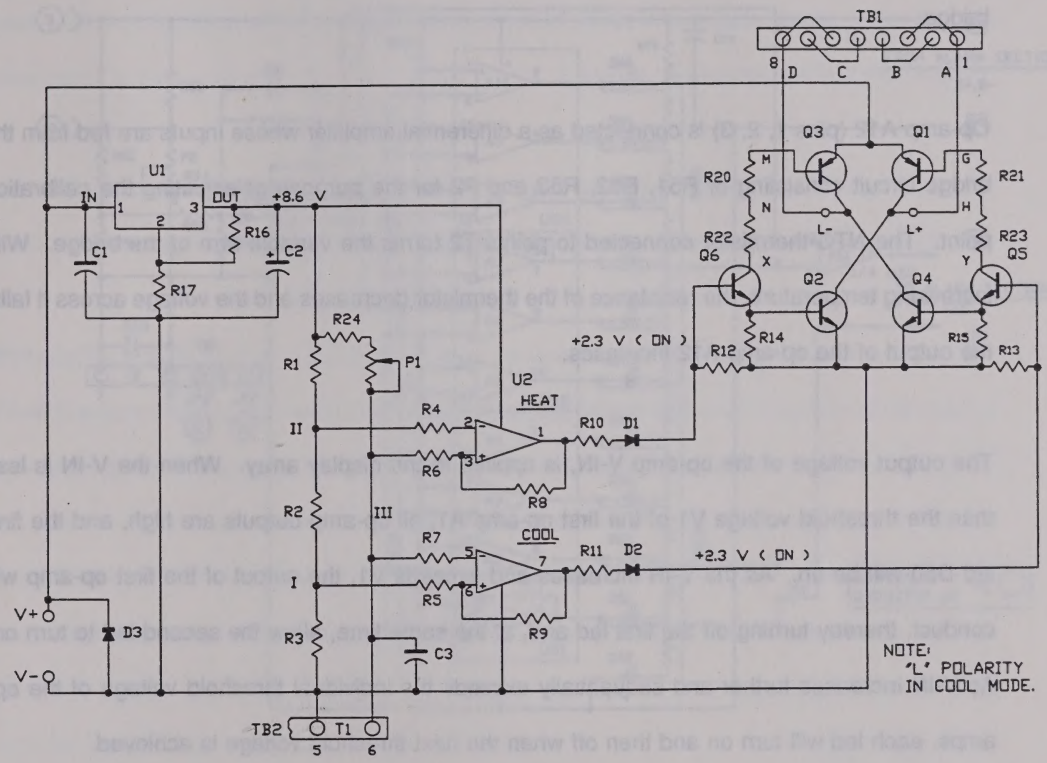


Figure 10
Temperature Control Section, Schematic CAT-024

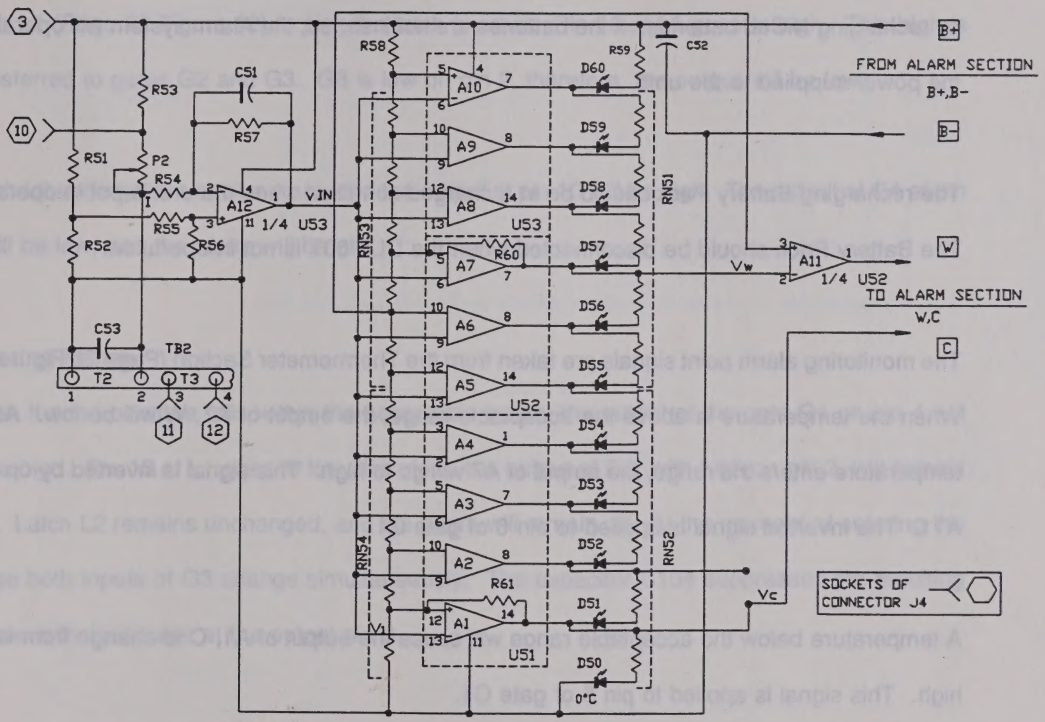
Control Board CAT-024, Thermometer Section

Page 25 Figure 11 Circuit Description D-2202

The thermistor T2 senses the compartment temperature. A change of the temperature at T2 causes a change of its resistance, and a corresponding voltage change at point I of the sensing bridge.

Op-amp A12 (pins 1, 2, 3) is connected as a differential amplifier whose inputs are fed from the bridge circuit consisting of R51, R52, R53 and P2 for the purpose of adjusting the calibration point. The NTC thermistor connected to points T2 forms the variable arm of the bridge. With increasing temperature, the resistance of the thermistor decreases and the voltage across it falls, the output of the op-amp A12 increases.

The output voltage of the op-amp V-IN, is applied to the display array. When the V-IN is less than the threshold voltage V1 of the first op-amp A1, all op-amp outputs are high, and the first led D50 will be on. As the V-IN increases and exceeds V1, the output of the first op-amp will conduct, thereby turning off the first led and, at the same time, allow the second led to turn on. As V-IN increases further and sequentially exceeds the individual threshold voltage of the op-amps, each led will turn on and then off when the next threshold voltage is achieved.



D-2202

Figure 11
Thermometer Section, Schematic CAT-024

Control Board CAT-024, Alarm Section

Page 29 Figure 12 Circuit Description D-2203

The DLA-50T incorporates an audio-visual alarm system, automatically activated when the compartment temperature falls outside the acceptable range. The alarm is powered continuously by recharging NiCad batteries. If the batteries are not inserted, the Alarm system will operate on the power supplied to the unit.

The recharging Battery Pack should be in a charged condition when the unit is put in operation. The Battery Pack should be disconnected when the DLA-50T is not in operation.

The monitoring alarm point signals are taken from the Thermometer Section (Page 25 Figure 11). When the temperature is above the acceptable range, the output of A7, W will be low. As the temperature enters the range, the output of A7 will go to high. This signal is inverted by op-amp A11. The inverted signal is applied to pin 6 of gate G1.

A temperature below the acceptable range will cause the output of A1, C to change from low to high. This signal is applied to pin 5 of gate G1.

Page 30 Figure 13-A shows the performance of the monitoring signals.

Following is the description of the Alarm Logic System (Page 30 Figure 13-B).

Switch On

When the circuit is switched on, the capacitor C103 is charged and creates a pulse on pin 13 of latch L1 (Page 29 Figure 12) forcing the latch to reset. Pin 10 of L1 goes to high. This high is transferred to gates G2 and G3. G3 is low on pin 2, therefore, the output will be low.

Latch L2 undergoes a similar reset, and the output at pin 10 will be high. The output of G4 at pin 4 will be low, and the alarm will be off.

Entering Range

When the temperature falls within the acceptable range, the output of the gate G1 on pin 4 will go to high. Pin 10 of L1 goes to low, therefore, the output of G3, with high on pin 2, will remain low. Latch L2 remains unchanged, and the alarm will remain off. At the moment of entering the range both inputs of G3 change simultaneously. The capacitor C104 suppresses the resulting narrow transient pulse at the output pin 3.

Leaving Range

A high will appear on the input of G1, causing a low on pin 4. Latch L1 remains unchanged. G3 will have both inputs low and a high will appear on the output at pin 3. Latch L2 is caused to change status and a low appears on output pin 10. Therefore, G4 is low on pin 6, and has pulses on pin 5. The output of G4 will be pulsed signals on pin 4, which are applied to transistor Q11, driving the audio-visual signals D5, and D6. The pulses are provided by pulse generator U12, which provides 1Hz pulses with a 50% duty cycle.

Reset

When the lever of S1 is pressed down to the RESET position, a high pulse is created by pin 13 of L1 and L2, causing the resetting of the latches. The output of L1 will stay low. If the temperature is outside the range, L1 will change, and its output will go to high. L2 will go to high on pin 10. The alarm will remain off, and the system will be in the monitoring mode.

Test

When the lever of S1 is pushed up to the TEST Position, R53 is shortened, simulating a condition of entering and leaving the acceptable range. The system will therefore go into, and stay in the alarm mode until the lever is pressed down to the RESET Position.

The current limited voltage regulator U15, provides 8.2VDC to the Thermometer and Alarm Sections, and supplies a charge current to the NiCad Battery Pack.

D103 is a reverse voltage protection diode. R122 protects the NiCad batteries against short circuits.

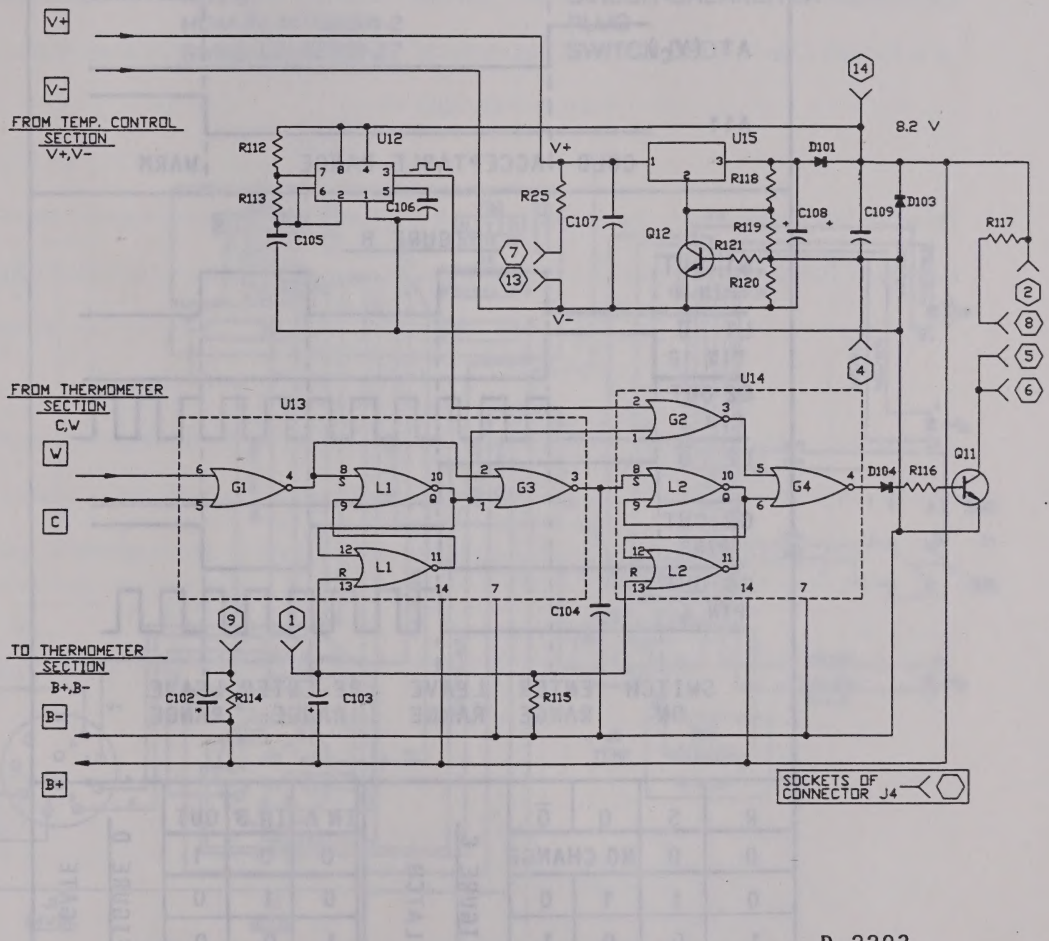


Figure 12
Alarm Section, Schematic CAT-024

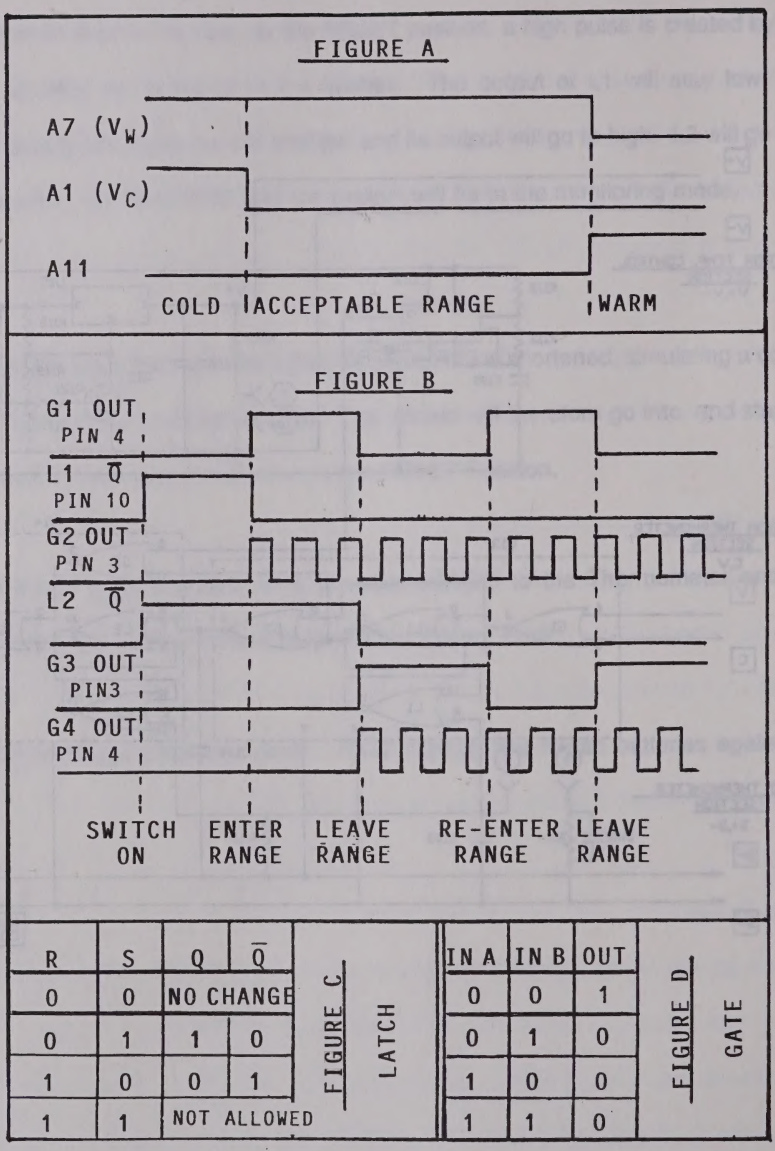


FIGURE C — LATCH

R	S	Q	$\overline{Q}$
0	0	NO CHANGE	
0	1	1	0
1	0	0	1
1	1	NOT ALLOWED	

FIGURE D — GATE

IN A	IN B	OUT
0	0	1
0	1	0
1	0	0
1	1	0

Figure 13
Alarm, Logic Diagram CAT-024

Parts List of Control Panel

J3	Connector MS-3102A-14S-05S	BOX MOUNTING RECEPTACLE
D4	Diode Lite 249-7967-3332-504	LED LAMP GREEN
D5	Sonalert SC 628M	AUDIO SIGNAL
D6	Diode Lite 249-7868-3331-504	LED LAMP RED
CB1	KD1-8	CIRCUIT BREAKER 8A
P4	HDM-20 M24308/4-2	PLUG
S1	Switch MS-35059-27	SWITCH DPDT

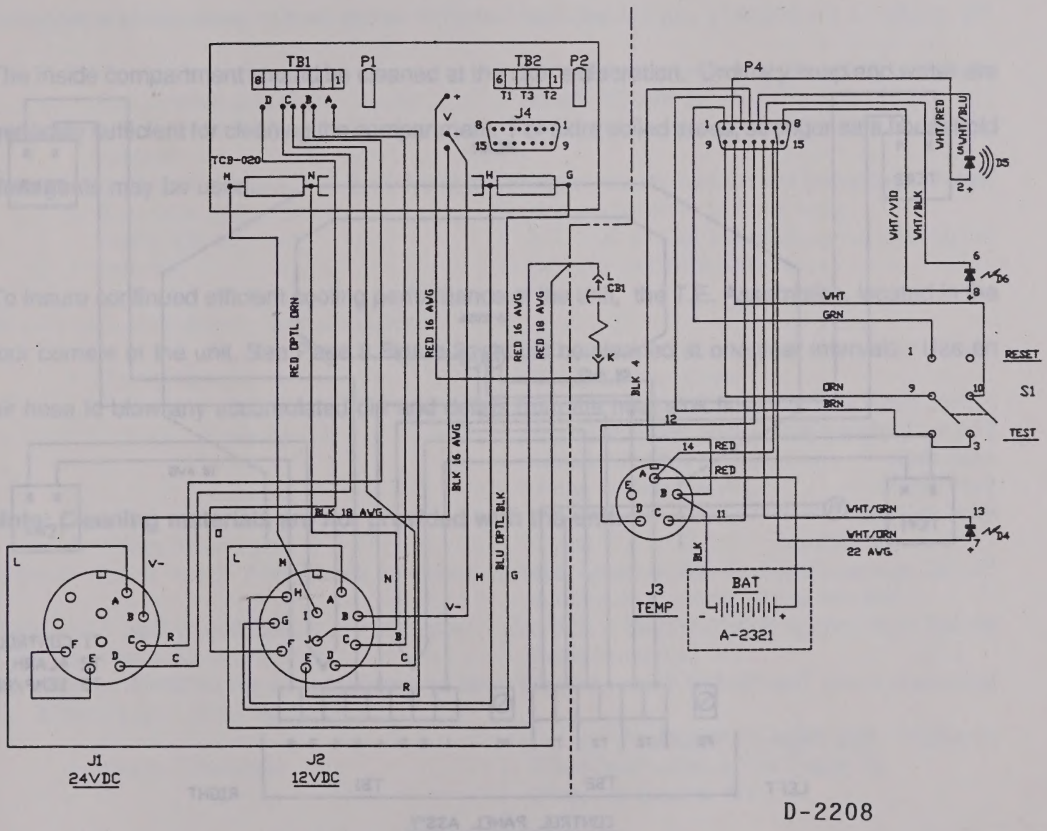


Figure 14
Control Panel, Wiring Diagram

1-7. Remote Thermometer/Recorder Connection

The DLA-50T incorporates a temperature sensor T3, to remotely monitor the compartment temperature. The connection to the sensor is provided through the connector J3 marked TEMP on the Control Panel. This connector also provides power for a Remote Temperature Recorder or a Remote Thermometer. (Page 10 Figure 4)

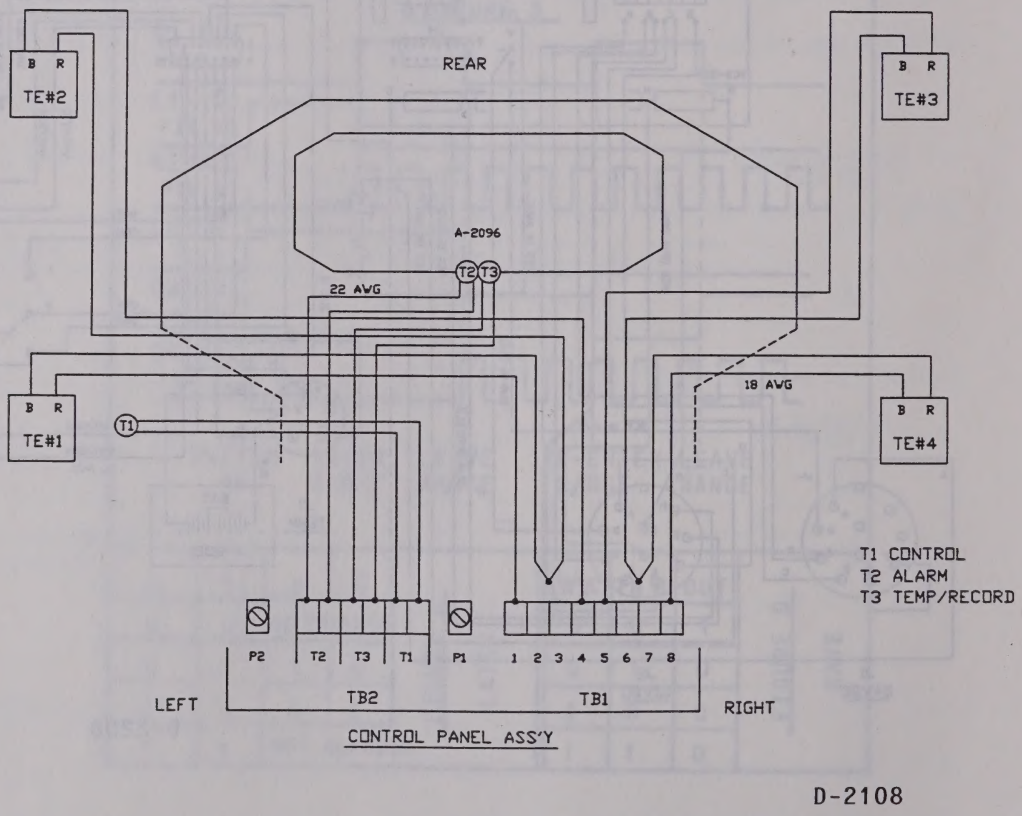


Figure 15
DLA-50T - Wiring Diagram

Section 2
Preventive Maintenance

2-1. General

Since the DLA-50T is a Solid State device and has no moving parts, it is virtually maintenance free, and there is only one preventive maintenance task to perform:

KEEP THE UNIT CLEAN

The inside compartment should be cleaned at the user's discretion. Ordinary soap and water are generally sufficient for cleaning the compartment. For extra soiled areas, stronger safe household detergents may be used.

To insure continued efficient cooling performance of the unit, the T.E. Assemblies, located in the four corners of the unit, See Page 8 Figure 2, should be cleaned at one year intervals. Use an air hose to blow any accumulated dirt and debris from the heat sink fins.

Note: Cleaning materials are not provided with the unit.

Section 3
Troubleshooting

CAUTION: Troubleshooting and maintenance to be performed by qualified personnel only!

3-1. General

The DLA-50T is a highly reliable instrument. However, if the DLA-50T does not operate to specifications, visually inspect the unit for obvious causes. If a visual inspection fails to reveal the source of the problem, use the troubleshooting list in this Section as an aid in locating and correcting the problem.

Before attempting to troubleshoot any malfunction of the DLA-50T, make sure the power source is correctly connected.

List of required tools for troubleshooting the DLA-50T unit

Philips head screwdriver (#2)
Flat screwdriver (medium)
Multimeter
Side cutters
Wire stripper

For AC power: Check to verify voltage selector switch of the PS-50B Power Supply is set to correct main voltage outlet 120VAC or 220VAC. (Designation on Power Supply Box: 115 or 230).

Important Note: The PS-50B Power Supply must be connected to the 24/28VDC plug of the DLA-50T. See Page 44 Figure 18.

For DC power: Use Power Cable A-2089, supplied with the unit, to connect the DLA-50T to your DC source (12VDC or 24/28VDC).

Important Note: Connect Red clip (+) to Positive and Black clip (-) to Negative.

3-2. Troubleshooting List

I. Unit does not function. Green Power indicator light is OFF, (Page 10 Fig. 4)

1. Power Circuit Breaker OFF	Push back RESET button.
2. Connection faulty	Check connections and polarity. Correct if necessary.
3. Power does not get to the unit	Check and correct continuity of the Power Cable.

II. Unit does not function. Green Power indicator light ON.

1. Source voltage is not corresponding to the selected operating voltage.	Check and correct voltage setting of the AC selector switch of Power Supply PS-50B.
2. Source is incapable to supply the required current.	Use appropriate power source. AC - 120 or 220 Volts DC - 12 or 24-28 Volts.

III. Unit does not perform to specifications.

1. Faulty Module.	Check current draw. Normal 2.5-3 Amps at 24VDC. If outside limits, locate and replace faulty T.E. Assembly. (Page 36 Section 4-2.)
2. Faulty Thermistor.	Check Thermistor (T1) resistance, 10K Ohms at 25° C. Replace if necessary. (Page 39 Section 4-3)
3. Faulty Control Board.	Replace board.

IV. Alarm System does not function.

1. Faulty Thermistor.	Check and replace Thermistor T2 (Page 40 Section 4-4)
2. Faulty Control Board.	Replace board.

Section 4
Corrective Maintenance

4-1. General

The procedures given below, describe how to locate, remove and replace defective components of the DLA-50T.

List of tools required to replace defective components of the DLA-50T.

(1) All tools listed for trouble shooting on Page 31
(2) Rivetting Gun (Pop)
(3) Soldering Gun (60 Watts)
(4) Solder (60/40 with Rosin Core)
(5) Heat Shrink Gun (650° F)
(6) Heat Shrink Tubing (1/8", 3/16")
(7) Conductive Grease
(8) Non-conductive Silicone Adhesive
(9) Hand Drill 1/4"
(10) 1/8" Drill Bit

4-2. T.E. Assembly

A. Locating defective T.E. Assembly #1, #2, #3 or #4

1. Remove the 10 screws securing the Control Panel to the unit.
2. Carefully pull the Panel back by 1/2 inch, top end only, to expose the Terminal Block TB-1.
3. Disconnect wires 1 and 4 from TB-1 and connect them to a 12VDC power source, the current reading should be 2-3 Amps.
4. Repeat Step 3 with wire pair 5-8.
5. Determine the pair with the defective T.E. Assembly
6. Cut the connection between the two T.E. Assemblies behind the Control Panel. Wires 2-3 or 6-7 respectively.
7. Connect a 6VDC power source to the leads of each T.E. Assembly between 1-2; 3-4; 5-6; 7-8. The current reading should be 2-3 Amps.
8. Determine the defective T.E. Assembly.

Note: T.E. Assembly #1 Page 38 Figure 16 (PN A-2437 contains thermistor T1)

B. Removal of T.E. Assembly Page 8 Figure 2

1. Drill out 10 pop rivets, securing the Corner Cover to the unit. Use a 1/8 inch diameter drill. Remove Corner Cover.

2. Remove the 4 screws located inside the cooling compartment securing the defective T.E. Assembly.

3. Remove the T.E. Assembly from the unit, pulling the red and black wiring out of the insulation foam. See Page 8 Figure 2.

C. Replacement of the T.E. Assembly - SEE NOTE

1. Thoroughly wipe clean the top surface of the Module Support (Page 38 Figure 16) and the Mounting surface in the corner mounting cavity.

2. Apply a thin, uniform film of Thermal Compound to the top surface of the Module Support (2) and to the mounting surface.

3. Thread the T.E. Assembly red black lead wires through the insulating foam, into the Front Panel cavity.

4. Position the T.E. Assembly in the mounting cavity, and tighten four screws from the inside of the cooling compartment.

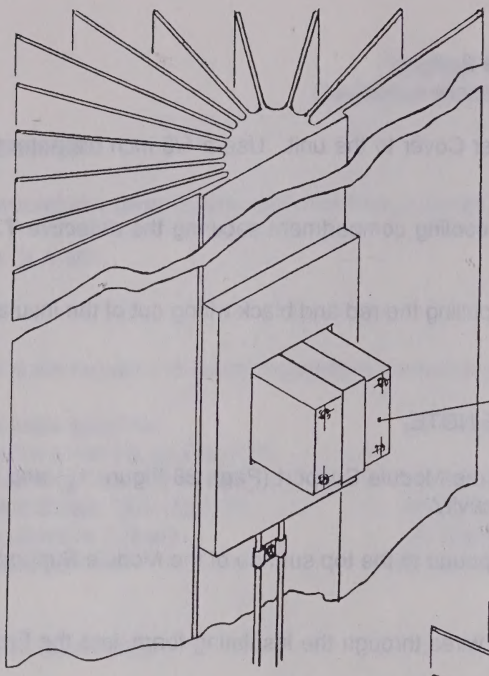
5. Splice the T.E. Assembly's leads, and apply tape over the leads.

6. Secure the Corner Cover with 1/8" D pop rivets.

7. Reconnect 1,4,5 and 8 wires to TB1.

8. Secure the Front Control Panel with 10 screws to the unit.

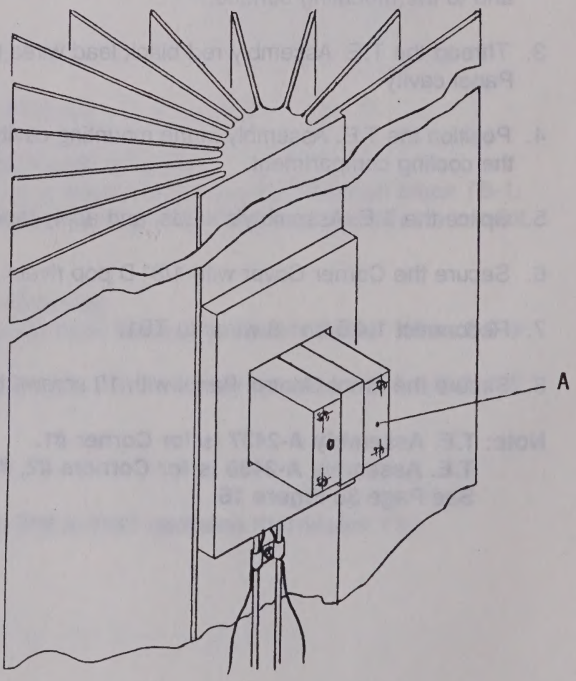
Note: T.E. Assembly A-2437 is for Corner #1.
T.E. Assembly A-2436 is for Corners #2, #3 and #4.
See Page 38 Figure 16



T.E. ASSEMBLY
PN A-2436
CORNER #2, 3 and 4

A

NOTE:
A- TOP SURFACE OF MODULE SUPPORT



A

T.E. ASSEMBLY
INCLUDING THERMISTOR T1
PN A-2437
CORNER #1

Figure 16
T.E. Assembly

4-3. Temperature Control Thermistor T1

A. Checking

1. Remove 10 screws securing the Control Panel to the unit.

2. Carefully pull the Panel back by 1/2 inch, to expose the Terminal Block TB-2.

3. Disconnect wires T1 from TB-2 and check resistance. Meter should read 10K ohms at 77°F (25° C).

B. Replacement of the T.E. Assembly including Thermistor T1.

1. Drill out 10 pop rivets, securing the front left Corner Cover to the unit. Use a 1/8" D drill. Remove Corner Cover. (Corner #1 Page 8 Figure 2)

2. Remove 4 screws securing the T.E. Assembly #1 from the inside of the cooling compartment.

3. Remove the T.E. Assembly from the unit.

4. Thoroughly wipe clean the top surface of the Module Support (Page 38 Figure 16) and the Mounting surface in the corner mounting cavity.

5. Apply a thin, uniform film of Thermal Compound to the top surface of the Module Support (Page 38 Figure 16) and to the mounting surface.

6. Thread the T.E. Assembly red and black lead wires with the thermistor wires through the insulating foam, into the Front Panel cavity.

7. Position the T.E. Assembly in the mounting cavity, and tighten four screws from the inside of the cooling compartment.

8. Splice the T.E. Assembly's leads, and apply tape over the leads.

9. Secure the Corner Cover with 1/8" D pop rivets.

10. Reconnect 1 and 4 wires to TB1, and the T1 wires to TB2.

11. Reset load compartment temperature with P1, (Page 18 Figure 8). To lower or raise the temperature, turn P1 clockwise or counterclockwise respectively, approx. 2 turns per 1°F (1/2°C).

12. Secure the Front Control Panel with 10 screws to the unit.

4-4. Thermometer Thermistor T2

A. Checking

1. Remove 10 screws securing the Control Panel to the unit, (Page 8 Figure 2)

2. Carefully pull the Front Panel back by 1/2 inch, to expose the Terminal Block TB-2.

3. Disconnect wire T2 from TB-2 and check resistance. Meter should read 10K ohms at 77°F (25° C).

B. Replacement

1. Disconnect wires T3 from TB-2.

2. Remove the faulty Thermistor Probe Assembly from Housing Tube by pulling the assembly out of the tube.

3. Install new Thermistor Probe Assembly A-2223 into the Housing Tube.

4. Reconnect wires T2 and T3 to TB-2.

5. Reset Thermometer with P2. To lower temperature setting, turn 3 turns clockwise or counter clockwise per approximately 1° F.

6. Secure the Front Panel with 10 screws to the unit.

4-5. Remote - Thermometer/Recorder Thermistor T3

A. Checking

1. Remove 10 screws securing the Control Panel to the unit, (Page 8 Figure 2)

2. Carefully pull the Front Panel by 1/2 inch, to expose the Terminal Block TB-2.

3. Disconnect wire T3 from TB-2 and check resistance. Meter should read 3K ohms at 77° F (25° C).

B. Replacement

1. Disconnect wires T2 from TB-2.

2. Remove the faulty Thermistor Probe Assembly from the Housing Tube by pulling the assembly out of the tube.

3. Install new Thermistor Probe Assembly A-2223 into Probe Housing Tube, reconnect wires T2 and T3 to Terminal Block TB-2.

4. Secure the Front Panel with 10 screws to the unit.

Section 5
Power Supply PS-50B

5-1. General

The PS-50B is a rectifier power supply, designed specifically to provide the power to operate the DLA-50T refrigerator from a 120VAC or 220VAC, 50/60Hz in sheltered environments. The input voltage is selectable by the AC select switch of the PS-50B Power Supply, (Page 9 Figure 3).

5-2. Description and Specifications

The PS-50B Power Supply is well protected within a closed metal box. Two cables extend from the unit. One cable connects the main AC source to the power supply, and one cable connects the power supply to the 24/28VDC receptacle of the DLA-50T Control Panel marked 24/28VDC, (Page 10 Figure 4).

Electrical Parts List of PS-50B Power Supply PN A-2160-3

TR 201	TRANSFORMER	115/230 PRI;21.7 SEC. VDC
D 201	BRIDGE RECTIFIER	50V 25A
C 201	CAPACITOR	4900 MF, 50VDC
R 201	RESISTOR	2200 OHMS ±10%, 5W
CB 201	CIRCUIT PROTECTOR KD-1	3 AMPS
S 201	VOLTAGE SELECT SWITCH	115/230VAC
P 201	PLUG	MS-3106A-18-01S

5-3. Installation

The PS-50B Power Supply is mounted on the back of the DLA-50T unit. When correctly mounted, the mounting latch will be on top. (Page 44 Figure 18)

Insert the PS-50B slotted spacer plate into the mounting bracket on the back of the DLA-50T unit and fasten the latch located on the top of the Power Supply assembly. (Page 44 Figure 18)

Both cables, the main AC Power Cable and the DC Power Cable, will come out the bottom of the Power Supply when mounted correctly.

Connect the DC Power Cable to the 24/28VDC receptacle of the DLA-50T Front Panel.

Set the AC selection switch to the correct AC voltage main, plug in to operate the unit.

NOTE: The Ps-50B is supplied with a 120VAC plug. Connect an appropriate plug for operation in other locations.

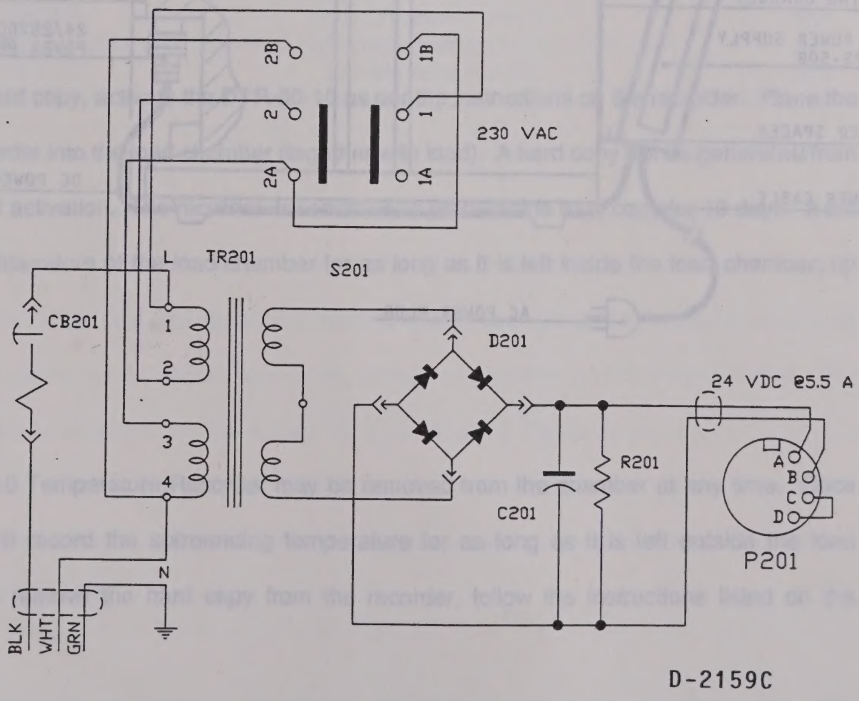


Figure 17
Power Supply PS-50B, Schematic

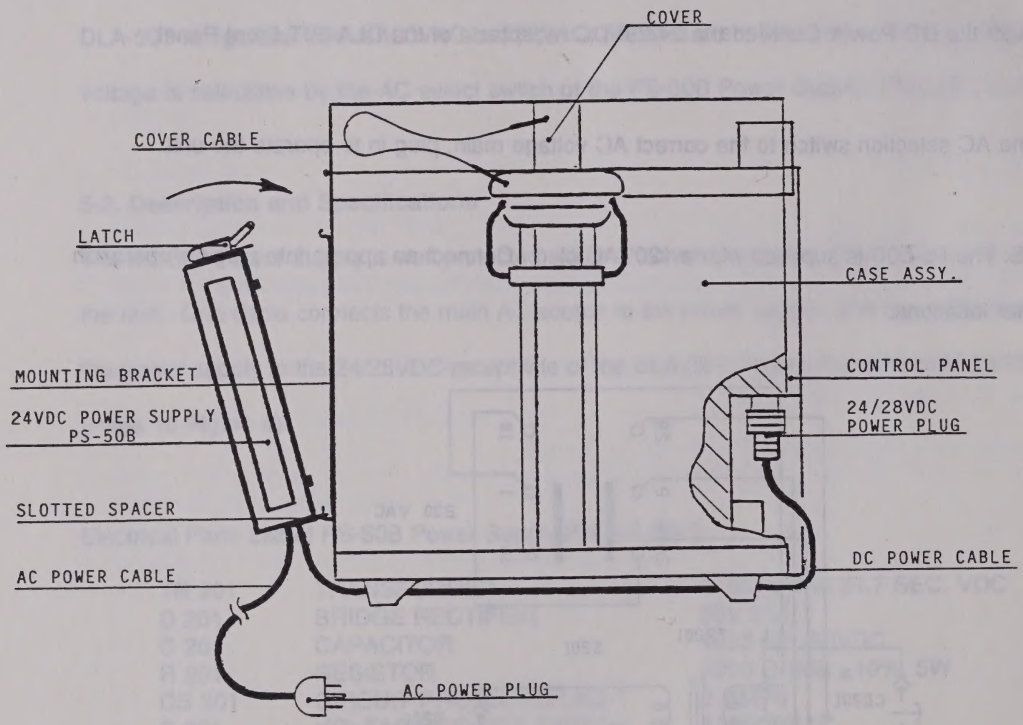


Figure 18
Attaching the PS-50B

Section 6
DTR-50-10 Hard Copy Recorder

6-1. General

The DTR-50-10 Temperature Recorder is a highly reliable instrument. The drive mechanism is tested and adjusted to close tolerances. The temperature coil is welded into place and cannot get out of adjustment.

The DTR-50-10 PN A-2224-2 will provide a hard copy of the temperature maintained within the load chamber of the DLA-50T unit.

6-2. Activation

To obtain a hard copy, activate the DTR-50-10 as per the instructions on the recorder. Place the activated recorder into the load chamber (together with load). A hard copy will be generated from the moment of activation. The recorder will continue to produce the hard copy for 10 days. It will record the temperature of the load chamber for as long as it is left inside the load chamber; up to 10 days.

6-3. Removal

The DTR-50-10 Temperature Recorder may be removed from the chamber at any time. Once removed, it will record the surrounding temperature for as long as it is left outside the load chamber. To remove the hard copy from the recorder, follow the instructions listed on the recorder.

Section 7
Equipment

7-1. General

All equipment required for the operation of the DLA-50T Thermopol Refrigerator in the United States is supplied with the unit. If, however, the unit is to be used in a geographical area in which the standard AC power is 230VAC, a local conversion plug must be used.

7-2. List of Supplied Equipment

Quantity	Description	Part #
1ea.	Refrigerator: DLA-50T	A-2244-2
1ea.	Rectifier Power Supply: PS-50B	A-2160-3
1ea.	Wire Basket: WB-30B	A-2428
1ea.	Power Cable: PC-30B	A-2089
1ea.	Temperature Recorder: DTR-50-10	A-2224-3
2ea.	Maintenance Manual	DLA-50T-MM1
2ea.	Operational Manual	DLA-50T-OP1

7-3. List of Required Equipment - Not Supplied

NONE

Section 8
Installation

8-1. General

The following information should be used to assist in the prompt set-up of the DLA-50T Blood and Vaccine Refrigerator. These directions for unpacking and installation will considerably ease initial set up, and avoid unnecessary mistakes.

8-2. Proper Location of Equipment

The DLA-50T is designed to operate at ambient temperatures of between -13° F (-25° C) and 120° F (49° C) as per Climatic Criteria AR 70-38; QSTAG 360.

8-3. Assembly Interconnections

The Battery Pack PN A-2321 should be mounted directly to the Control Panel. The two slotted screws should be securely fastened. When in storage, loosen the two slotted screws to disconnect the Battery Pack. (Page 8 Figure 2)

For AC operation, the PS-50B Rectifier Power Supply PN A-2160-3 can be mounted on the rear mounting bracket of the DLA-50T Blood and Vaccine Refrigerator, (Page 44 Figure 18). It should then be connected to the 24/28VDC receptacle, located and marked on the Control Panel. The AC cable should be plugged into the correct AC main. (Page 9 Figure 3)

For DC operation, use the Power Cable A-2089, supplied with the DLA-50T. Connect the cable between the DC power source and the corresponding connector located and marked on the Front Panel. (Page 8 Figure 2)

Note: When properly connected, the Green power indicator light should be on. No switching is needed.

Section 9
Operation

9-1. Initial Adjustments

The DLA-50T is factory set for normal operation. No initial adjustments are necessary.

The PS-50B Power Supply is factory set to 110VAC. If used at a 230VAC location, the Power Supply must be set to local voltages. To adjust, use a flat screwdriver and move the slide switch to the 230VAC position, as indicated on the PS-50B Power Supply.

NOTE: Connect an appropriate AC power plug for operation in other than 110VAC locations.

9-2. Starting, Operating and Stopping the Equipment

To start the operation of the DLA-50T, the unit must be connected into an appropriate power source. Once the unit has been properly connected, the green power indicator light will be on. No switching or adjusting is necessary.

The connector receptacles, switches and indicators of the unit are all located on the Control Panel and are marked with their functions. (Page 10 Figure 4)

Steps for starting the unit in operation:

1. Source Voltage Determination

Ascertain available power source voltage: 110VAC, 220VAC, 12VDC or 24-28VDC.

2. Connection to Unit

Connect the DLA-50T in accordance with the source voltage:

Source	Connection	Receptacle
12VDC	Power Cable PN A-2089	J2 - 12VDC
24/28VDC	Power Cable PN A-2089	J1 - 24VDC
110VAC or 220VAC	Power Supply Plug	J1 - 24VDC

3. Installation of Alarm Battery Pack

Install a charged Battery Pack in the Front Panel recess, (See Page 8 Figure 2). The indicator of the Compartment Thermometer will light. If the battery voltage is low, no light will appear on the Thermometer. The Battery Pack will charge automatically when power is provided to the unit. To ascertain the performance of the Battery Pack, disconnect the DLA-50T after approximately 15 minutes and observe the light on the Thermometer, indicating proper operation.

Note: The Alarm and Thermometer will operate with or without the Battery Pack when power is provided to the unit.

4. Alarm/Battery System Test

Push the lever of the Alarm Switch, located on the Control Panel, up to the Test position. The temperature indicators will light sequentially and momentarily. The Red Alarm Light will blink and the sound signal will beep. Push the lever of the Alarm Switch down to the Reset position. The Alarm Mode will be off.

5. Connection to DC voltage

For 12VDC or 24-28VDC, the red positive clip of the D.C. Power Cable must be connected to the positive (+) contact of the source, and the black negative clip, to the negative (-) contact of the source.

6. Connection to AC Voltage

For AC operation, the PS-50B Power Supply is plugged into an AC main. Check and set correct voltage of the Power Supply before connecting the DLA-50T.

When correctly connected and powered, the green power indicator on the Control Panel will light, and the DLA-50T will be in operation. The compartment temperature will be indicated by the color coded, solid state thermometer changing from red to yellow to green in the normal range. The DC plug of the PS-50B Power Supply must be connected to the 24/28VDC receptacle of the DLA-50T Front Panel, (Page 44 Figure 18).

The receptacle in the Front Panel marked TEMP is used to connect a Remote Temperature Recorder or a Remote Thermometer, (Page 10 Figure 4).

Steps for normal operation

Operation is maintenance-free as long as the unit is properly connected to a correct power source, it will maintain a compartment temperature of 35.6° F (2° C) to 42.8° F (6° C).

Steps for stopping operation

Stopping the equipment requires unplugging it from its power source. It is advisable to remove the Battery Pack while unit is not in operation.

If the unit is to be idle for an extended period of time, it is advisable to thoroughly wash the compartment with soap and water prior to storage.

9-3. Storage

The DLA-50T may be stored in a normally vented storage facility. Storage envronmental temperature of -25°F (-32°C) to 120°F (49°C) is acceptable.

Short term: Clean the unit's load compartment with a mild detergent. Store Power Cable, Power Supply, Battery Pack, and Recorder inside the clean load compartment.

Long term: Same as above. In addition, clean outside of unit by blowing an air stream over the unit. Blow dust and dirt from the 4 Heat Sinks located in the 4 corners of the unit. (Page 6 Figure 2). Place in a carton container or cover with a plastic bag. Place in a sheltered.

Section 10
List of Replacement Parts

10-1. General

The following parts list is in tabular form, with four columns: Part Number, Description, Quantity and Location Reference.

a. Part Number: the Thermopol Inc. part number.

b. Description: a brief functional description of the part.

c. Quantity: the number required for 1 complete subassembly.

d. Location: page number and figure in this manual, whenever applicable.

10-2. List

Part Number	Description	Quantity	Location Ref.
A-2219	**Case Assembly**	**1**	**Page 8 Fig 2**
P-2261	Rim	1	Page 8 Fig 2
P-2239	Hinge	1	Page 8 Fig 3
C-2091	Latch (Catch)	2	Page 8 Fig 2
P-2264	Handle	2	Page 9 Fig 3
P-2258	Cover, Corner	4	Page 8 Fig 2
A-2435	**Cover Door Assembly**	**1**	**Page 9 Fig 3**
P-2063	Gasket, Cover	1	Page 8 Fig 2
P-2257	Bracket, Strike	1	Page 8 Fig 2
C-2091-1	Latch	2	Page 8 Fig 2
P-2097	Door Cable	1	Page 8 Fig 2
P-2239	Hinge	1	Page 9 Fig 3
A-2436	**T.E. Assembly**	**1**	**Page 8 Fig 2**
A-2437	**T.E./Sensor Assembly** NOTE: In Corner #1 only!	**1**	**Page 8 Fig 2**

Part Number	Description	Quantity	Location Ref
A-2209-2	**Control Panel Assembly**	**1**	**Page 8 Fig 2**
A-2205	Control Board Assy	1	Page 17 Fig 7
A-2211	Panel, Front Assy	1	Page 8 Fig 2
C-4110-08	Circuit Protector KD8	1	Page 10 Fig 4
C-4105	Audio Alarm Signal	1	Page 10 Fig 4
C-4104	Alarm Test/Reset Switch	1	Page 10 Fig 4
C-4106-1	Visual Alarm Signal	1	Page 10 Fig 4
C-4106-2	Power Indicator	1	Page 10 Fig 4
P-2214	Interlock	1	Page 10 Fig 4
A-2160-3	**PS-50B Power Supply**	**1**	**Page 43 Fig 17**
C-2312	Transformer	1	Page 43 Fig 17
C-4107	Rectifier	1	Page 43 Fig 17
C-4108	Voltage Select Switch	1	Page 43 Fig 17
C-4109	Capacitor	1	Page 43 Fig 17
C-4110-03	Circuit Breaker KDI-3	1	Page 43 Fig 17
A-2439	24V Power Cable Assembly	1	Page 43 Fig 17
A-2440	Line Power Cable	1	Page 43 Fig 17
C-2091-1	Latch	1	Page 44 Fig 18
A-2321	**BP-50 Battery Pack**	**1**	**Page 44 Fig 18**
A-2089	**Power Cable**	**1**	**Page 8 Fig 2**
A-2420	**WB-30B Wire Basket**	**1**	**Page 8 Fig 2**
A-2223-2	**Thermistor Probe Assy**	**1**	**Page 8 Fig 2**
A-2224- 2	**DTR-50-10 Hard Copy Recorder**	**1**	
DLA-50T-MM1	**Maintenance Manual**	**2**	
DLA-50T-OP1	**Operational Manual**	**2**	

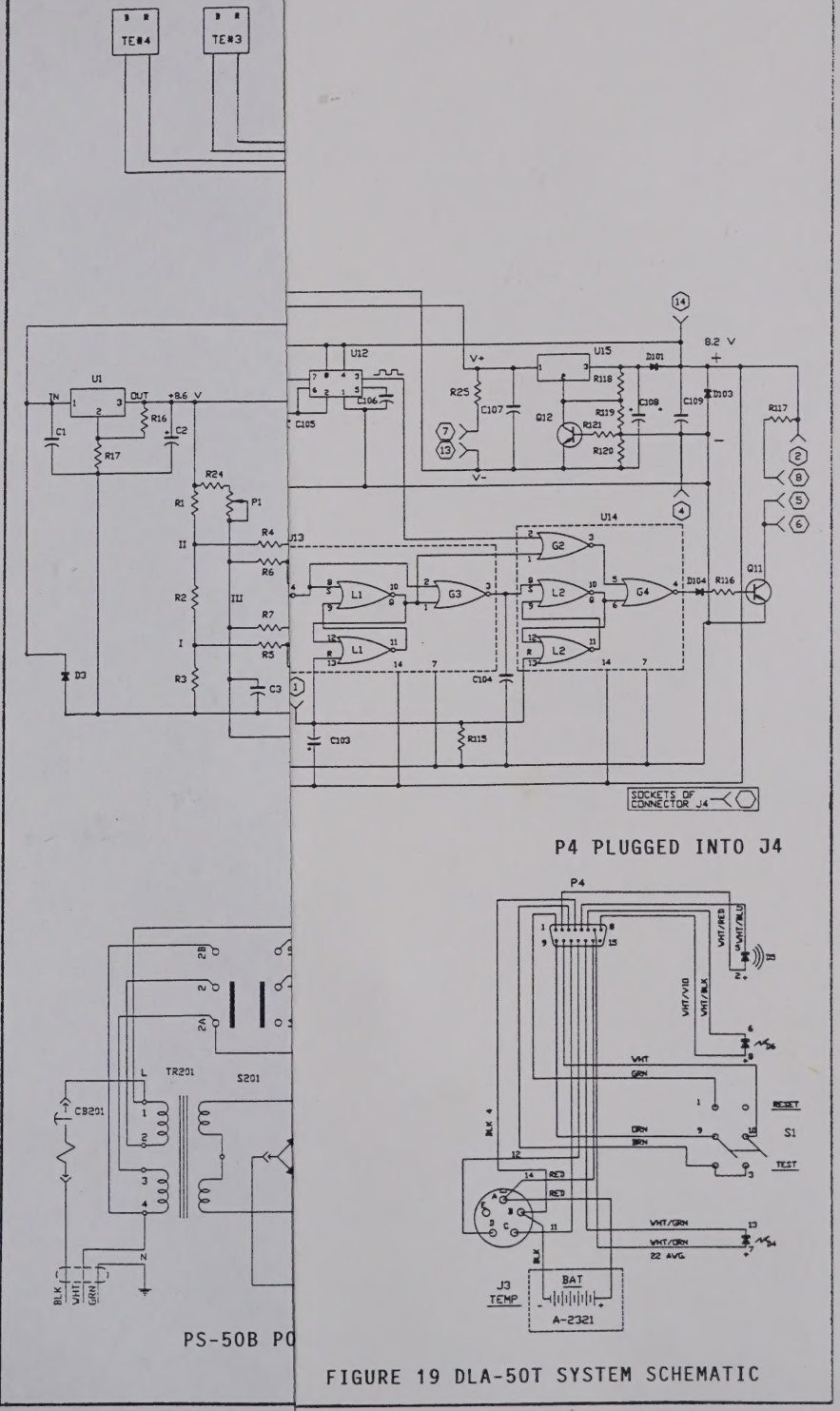
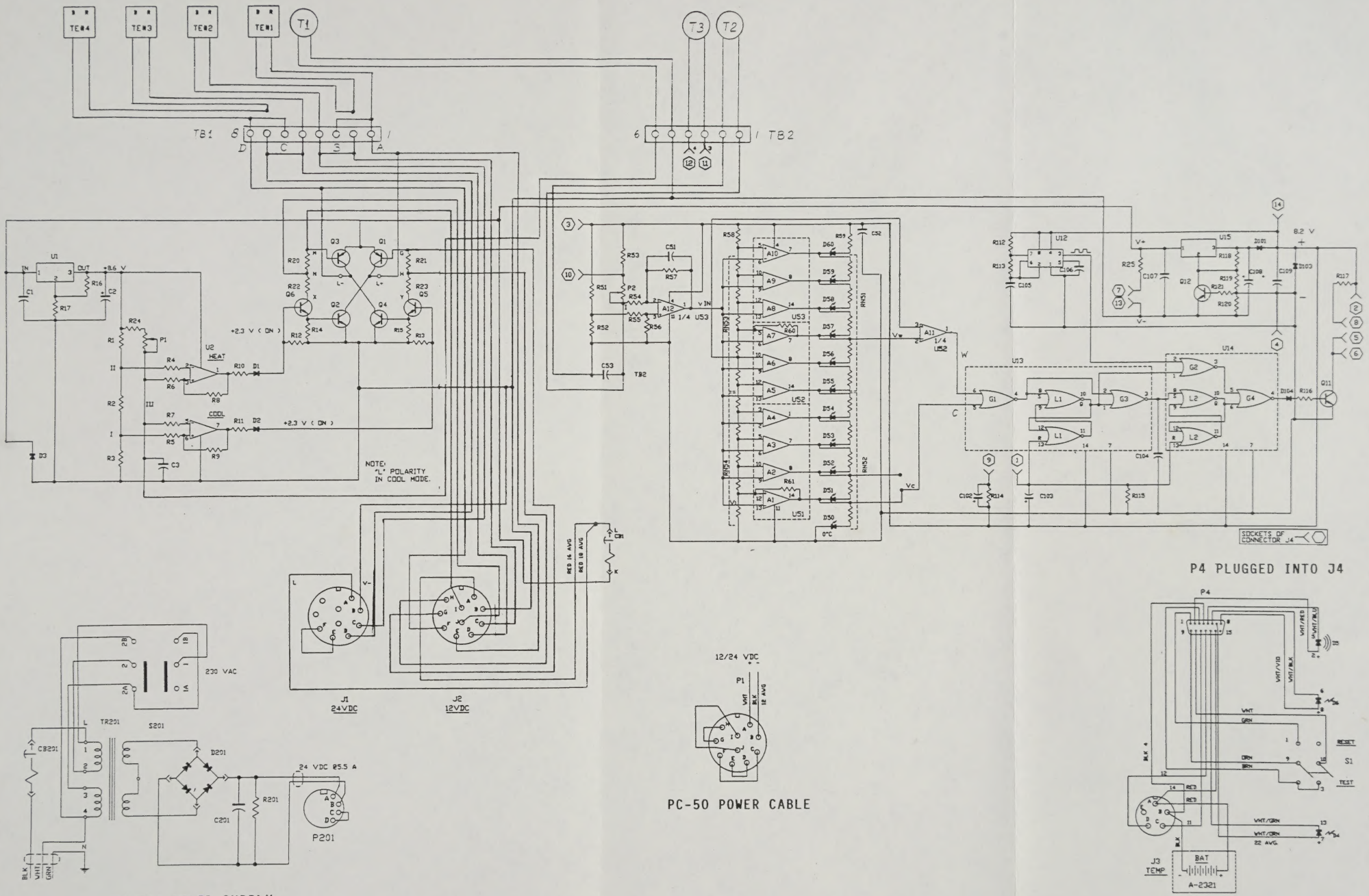


FIGURE 19 DLA-50T SYSTEM SCHEMATIC



P4 PLUGGED INTO J4

PS-50B POWER SUPPLY

PC-50 POWER CABLE

FIGURE 19 DLA-50T SYSTEM SCHEMATIC